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Tracking eye movements to gain insights into an older reader's reading practices

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Tracking eye movements to gain insights into an older reader's reading practices

Abstract

Perhaps you've met Patrick? Patrick (pseudonym) is in Year 5. He is a reader who struggles to cope with the reading demands of the Year 5 classroom. His teacher reports he is reluctant to read any genre of text, refuses to read aloud with the teacher or with another support person and becomes quite agitated when he encounters something he does not know in his reading. The reading challenges Patrick faces are more common in an emergent reader, but perhaps more difficult to address with an older reader where ineffective practices have become learned. In this paper, we share the case of Patrick, a Year 5 student participant in our EMMA project. EMMA is an acronym combining eye movement technology (EM) with miscue analysis (MA), an established reading assessment for understanding the way a reader orchestrates the reading process. Here, we consider what we can learn from the analysis of Patrick's miscues, from the retell accompanying that reading, and what is added when we have the opportunity to understand the ways Patrick uses his eyes as part of that meaning making process.

Keywords

movements, practices, reading, reader's, eye, older, tracking, into, insights, gain

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Tracking eye movements to gain insights into an older reader's reading practices

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ABSTRACT

Perhaps you've met Patrick? Patrick (pseudonym) is in Year 5. He is a reader who struggles to cope with the reading demands of the Year 5 classroom. His teacher reports he is reluctant to read any genre of text, refuses to read aloud with the teacher or with another support person and becomes quite agitated when he encounters something he does not know in his reading. The reading challenges Patrick faces are more common in an emergent reader, but perhaps more difficult to address with an older reader where ineffective practices have become learned. In this paper, we share the case of Patrick, a Year 5 student participant in our EMMA project. EMMA is an acronym combining eye movement technology (EM) with miscue analysis (MA), an established reading assessment for understanding the way a reader orchestrates the reading process. Here, we consider what we can learn from the analysis of Patrick's miscues, from the retell accompanying that reading, and what is added when we have the opportunity to understand the ways Patrick uses his eyes as part of that meaning making process.

We already know much about teaching and assessing reading

What can we do for our students whose reading development has not kept pace with the changing and increasingly sophisticated demands of the classroom?

Developing learners as 'good' readers is an ongoing goal for all teachers. And while the purpose of reading as a meaning making activity is uncontested in educational research and practice, just how children learn to read continues to be the subject of political and pedagogical debate. Current reading pedagogy involves a balance between explicit and systematic teaching of language skills (such as phonic and phonemic awareness) and teaching about semantic and syntactic cues related to a text's topic and structural features (Board of Studies, Teaching and Educational Standards (BOSTES), 2012a; Winch, Johnston, Holliday, Ljungdahl, & March, 2010).

We take the position that reading is a message-getting, problem-solving activity (Clay, 1991). It involves a transaction between the experiences, knowledge and expectations readers *bring to* a reading event and the information they *draw from* a text itself with the purpose of making meaning (comprehension). Goodman (1996) argues the reading process is the same for all readers and that effective (or 'good') readers are distinguished from less effective readers not by the reading process itself, but by the way they orchestrate the process.

A proven pedagogical tool for analysing a student's orchestration of the reading process is miscue analysis (Goodman, 1973, 1996). In miscue analysis, a reader's 'miscues' are the unexpected responses a reader makes when reading a selected text aloud. They are unexpected in that the reader's response differs from the words that are written in that text. For example, a reader may insert an extra word, they may omit one, and they may substitute one word for another, or reverse the order of the words as they appear in the text. By examining these miscues in relation to their semantic, syntactic and

graphophonic sources, a teacher can achieve a powerful ‘window onto the reading process’ (Goodman, Watson, & Burke, 2005, p. 11).

Accompanying a miscue analysis, a reader is also asked to ‘retell’ everything they can remember about the text they just read. A retell offers the reader an opportunity to articulate their understanding of the characters, events, facts, or even just the interesting parts of the text with which they engaged (Kervin, 2013). Once the reader indicates they have shared all they can remember, the teacher may prompt to specific events, characters or sections in the text to elicit more information about the reader’s recall of their reading. The retell provides further information for the teacher about the reader’s comprehension. A retell can elicit a reader’s literal and inferential understandings about the content of the text.

Combined, miscue analysis and retell generate data that a teacher can use to make judgments about a student’s reading that can inform future pedagogical approaches for reading teaching. Analyses of these data rely on what we observe when a student miscues and how they describe their understanding of their reading. These analyses are external observations of oral reading, limiting the depth of understanding we can achieve. Greater knowledge about where and how a student looks when reading on a page or screen, that is, their eye movements, could produce new and useful pieces in the reading process puzzle related to a reader’s application of the strategies for reading.

What can we learn by including eye movement data in our assessment?

Early eye movement research with adult readers has shown that rather than moving smoothly from left to right across a line, accomplished readers look directly at only 20–70% of words in a line, apparently reading some without directly looking at all or parts of a word (Paulson & Freeman, 2003). Eye movement technology tracks the minute movements of the reader’s eye as they read. It can detect the quickest of movements as the eye works to support the brain in the making of meaning. Eye movement data provides evidence of what a child *actually* does, as opposed to what it is they say they do. Combined with miscue analysis, eye movement technology offers a new perspective on the reading process that can support teachers’ understanding of the reading process, and so, help the most challenging students to read.

Our project

Our project combines eye movement (EM) technology with miscue analysis (MA) – EMMA – with the aim of examining *where* a child is looking *when* they miscue. We secured an equipment grant to purchase a pair of eye tracking glasses and the necessary analysis software, and a further partnership grant that enabled us to work with selected students from Kindergarten to Year 6 in a local New South Wales public primary school. Following ethics approval from our Human Research Ethics Committee and our State Educational Research Approval Panel, and the students and their parents, we began administering the EMMA.

In New South Wales, teachers rank children’s literacy learning on a *Literacy Continuum* (BOSTES, 2012b) in eight skill areas, one of which is ‘reading texts’. The continuum is marked out by clusters, which are aligned with approximate year levels. Listed within each cluster are the reading skills and strategies required for achievement. The principal and classroom teachers at our research site identified students in each year level whose assessments had revealed that they were struggling to achieve the clusters aligned with reading benchmarks for their year level. We carefully matched suitable texts with the identified reading abilities of those students.

Selection of text

As literacy teachers, we are well aware of the importance of text selection, and even more so when dealing with readers who are struggling to develop a strong reading process. A struggling reader will

be quickly daunted by a text that they consider too hard, or that has too many words on the page, or that is too long. And so, we analysed texts within the New South Wales *Suggested texts for the English K-10 Syllabus* (BOSTES, 2012c) using an adaptation of Pinnell and Fountas' (2006) text difficulty guide and matched them with the skills required within the *Literacy Continuum* clusters. In this analysis, we were able to consider the ways the text would support a reader, but also present challenges that would prompt the activation of their reading strategies.

The example shared in this paper is *Looking for crabs* by Bruce Whatley (1993), a picturebook with 15 double page spreads with 2–3 lines of text and large images on each. It relates the story of a family, narrated by the son, visiting the beach during winter. Because it is too cold to swim, they set about looking for crabs. These crabs, however, are quite crafty and remain hidden from the family, but not the reader. While the family leaves the beach declaring that there are 'No crabs at our beach!', the reader knows better, having been drawn into the secret and comical world of these crabs through the illustrations. *Looking for crabs* has a total of 201 words, and the text is located quite consistently in the top left hand quadrant on all but one of the double page spreads. The text difficulty analysis aligned it with the skills required for clusters 8–9, which is identified as the end of Year 2 and beginning of Year 3. According to the BOSTES (2012b) *Literacy Continuum*, a reader at clusters 8–9 reads longer texts for sustained periods, uses visual representations such as photographs and images in making meaning, and utilises effective strategies to maintain fluency and meaning.

Examining Patrick's reading practices

As a Year 5 student, Patrick's placement at cluster 9 on the continuum is obviously a concern, not only for his learning in the primary school setting, but in the challenges looming for him as he enters secondary school. We administered the EMMA (eye movement and miscue analysis) assessment with Patrick using two texts on two different days. Shared here is the case of his reading the first text, *Looking for crabs*. Patrick was introduced to *Looking for crabs* as a story about a boy and his family's exploration for crabs while on holiday at the beach. He was asked to read the story aloud, but to read as if he was alone. That is, if he came to something he didn't know, to do what he would normally do when reading by himself. This would give us insight into his independent reading practices.

What we learn about Patrick from the Miscue Analysis

Patrick's reading began accurately and smoothly. His early predictions were meaningful and some were monitored and corrected. See Figures 1 and 2 for an example.

7. Crabs can be difficult to find.

Figure 1. Patrick anticipates, substitutes and corrects: are/can

8. You have to look really hard,
9. but try not to scare them!
10. Dad says crabs are usually found

Figure 2. Line 10, Patrick corrects a substitution following an extended pause: useful/usually

However, as the text progressed, Patrick became increasingly flustered and appeared unable to match his responses with those in the text. Table 1 summarises selected miscues and provides insight into their possible sources. The *Text excerpt* column contains two rows in each cell. The text on top is what Patrick read, the text on the bottom shows what was written in the book, and a small © indicates Patrick corrected that miscue.

Text	Type of miscue	Text excerpt	Analysis of miscue
Line 13	Substitution	Mum says you have to try carefully. Mum says you have to tread carefully	Semantic and syntactically acceptable with use of initial letters. However, the meaning in the story is changed.
Line 15	Substitution	© But I did the that can be any. But I don't think there can be any	Following correction, there is semantic and syntactic acceptability with use of the initial letters. However, the meaning in the story is changed
Line 17	Substitution	© Evan Every when dad flips up a rock Even when dad lifted up a rock	Following correction, there is semantic and syntactic acceptability. Meaning is unchanged, but graphic and sound similarities are inconsistent.
Line 21	Substitution	But I think they will just hiding But I think they were just hiding	Meaning is changed and syntax is disrupted across the sentence. Has responded to the initial letter.
Line 27	Substitution	Repeat © 1.50 min pause We're doing the - - - - ¿ Where do they go in the holidays?	Following correction, graphic and sound similarity is strong. But semantic and syntactic information and the meaning are disrupted.
Line 28	Omission	- - - Dad suggested Hawaii (turned page).	Text is omitted, disrupting all sources of information.

Table 1. Sample of miscues in Patrick's reading

The excerpt in Table 1 contains 41 reading words. Of those, Patrick had 17 miscues and three corrections. Analysis of the miscues reveals an over-reliance on the first letters or clusters of letters in connection with predictions based on knowledge about English language structures.

What Patrick was able to retell

Patrick's retell was brief and required ongoing prompts to share more. When asked to talk about the story, Patrick stated, 'The crabs hide under little rocks, not big ones.' He listed as its characters '... a dad, a mum and a sister, and [pause] wait [pause] yeah, is that it?'. And he could remember that they were looking for crabs in the rock pool, the beach and under big rocks, 'and that's it'. Patrick indicated that when dad lifted up the big rock, there were no crabs under it, 'because they were hiding'. He did not identify anything of the parallel story told within the illustrations.

From his retell, Patrick demonstrates limited recall of the events in the story and struggles to articulate his retell beyond one sentence at a time. He does not recall the boy character, who is the

narrator, and who appears as the sole figure on the front cover and eight of the 15 double page spreads.

What we learn when we look at Patrick's eye movements

Patrick was observed to begin reading very quickly as soon as the book was opened. Eye movement recordings reveal that he quickly aligned himself with the consistent placement of the text in the top left hand quadrant of each double page spread, glancing only at the rich illustrative scenes as he turned the page. In fact, it was not until the fifth double page spread that Patrick was observed to scan the scene prior to reading the text. Perhaps it was his unawareness of the parallel story developed within the image sequences that limited Patrick's ability to retell the story in any complexity.

Patrick's full page scan midway through the text led to further scanning during the reading. Interesting here were the choices he made about when and what to scan and the success he experienced as a result. For example, on the 7th double page spread, three lines of text convey about Dad's efforts to find a crab:

Even when Dad lifted up
a really big rock
we didn't find any.

Patrick initially read the first word as 'every' and then realised his miscue. Eye movement data indicate he then looked to the image of dad's face and back to the initial word and pronounced it like the name 'Evan' with a short vowel sound for each /e/. He repeated this technique, scanning dad's face, the rock he was holding and the crab clinging on to its underside. He then corrected his miscue and continued to read. Figure 3 demonstrates Patrick's eye movements as he worked on this initial word.

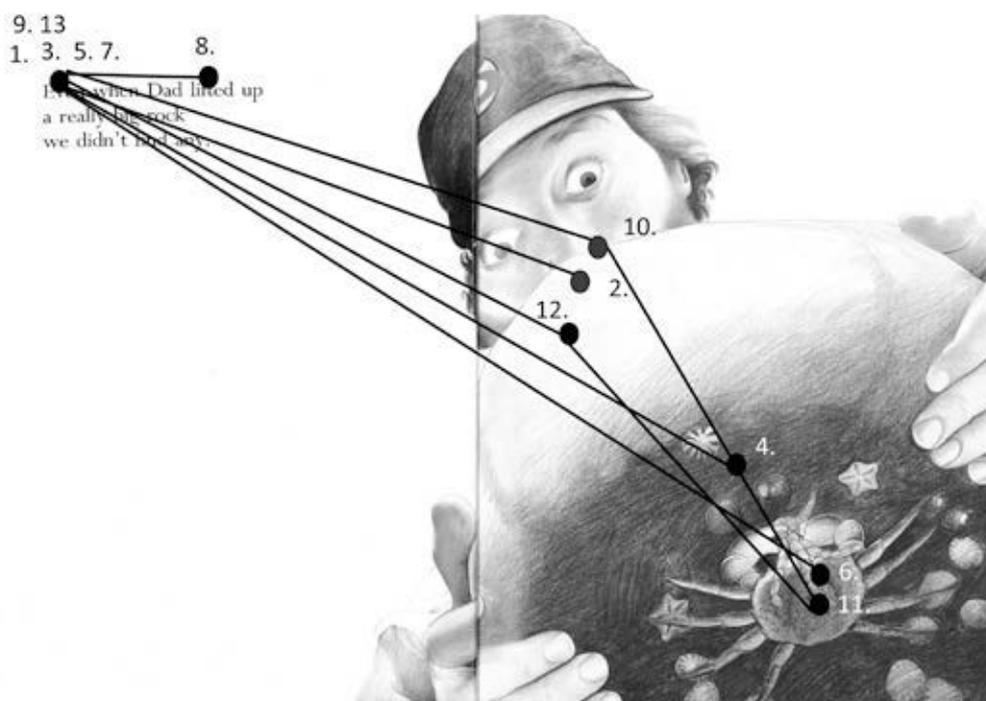


Figure 3. An excerpt of Patrick's eye movements as he read 'Even'
This image from *Looking for crabs* is reproduced with permission from author
Bruce Whatley and HarperCollins (Australia).

It appears at this stage of his reading that Patrick is starting to flounder with his control of the process. The eye movement data in Figure 3 suggests Patrick may have developed a limited repertoire of problem-solving strategies for unknown words beyond prediction based on the initial letter/s. It is

also interesting to note in the eye movement data Patrick's focus on the crab on the underside of the rock, since he indicated in his retell that there was nothing under the rock at all.

In another example, the family is sharing conjectures about where crabs may take their holidays. On this 11th double page, the text is again in the expected position at the top left hand quadrant of the page:

Where do they go in the holidays?
Dad suggested Hawaii.

As Patrick read, he paused at the word 'go' for a full minute and 50 seconds. Eventually, unable to solve the text, he omitted seven words and turned to the next page of the story. Table 2 outlines Patrick's action, his reading and the interactions between the teacher and student and Figure 4 captures a summary of Patrick's eye movements for the first 30 seconds of his reading of this double page.

Table 2. Patrick's reading process on the 11th double page spread

Student action	Student reading	Teacher/student talk
Patrick reads:	<i>We're doing the</i>	
[corrects]	<i>they</i>	
[rereads]	<i>We're doing they</i>	Patrick whispers 'wait'
[searches the page for 1 min]	-	Teacher prompts for a strategy
[searching, no response 50 secs]	-	Patrick: I can't read this page Teacher: What will you do?
[Patrick turns page and keeps reading]	-	

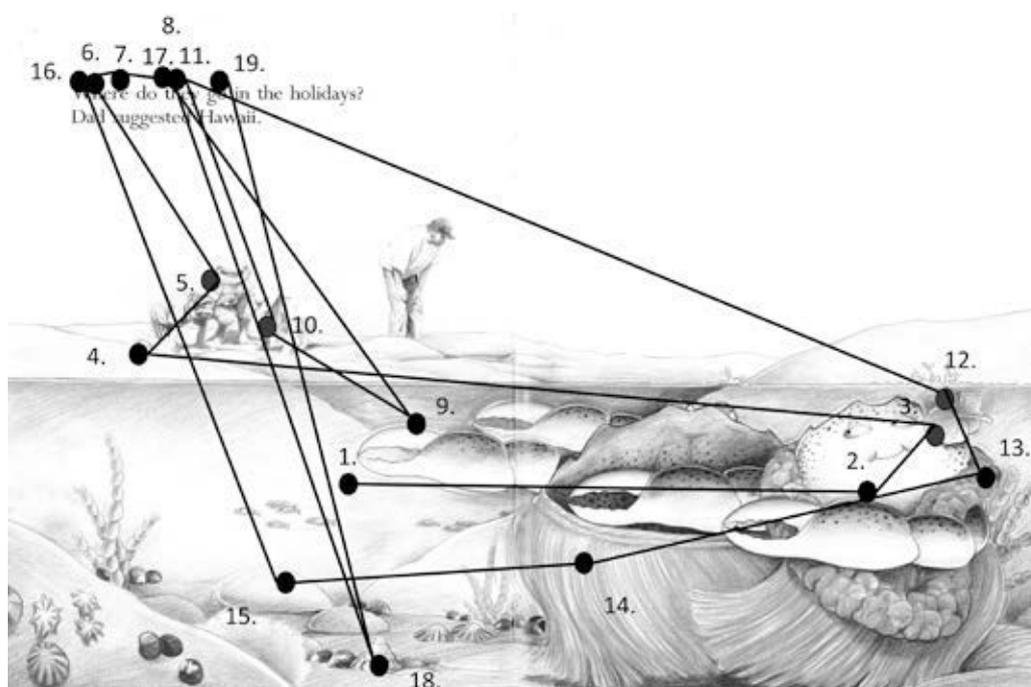


Figure 4. An excerpt of Patrick's eye movements, paused at 'go'
This image from *Looking for crabs* is reproduced with permission from author Bruce Whatley and HarperCollins (Australia).

It is tempting to think that Patrick perhaps does not know the word 'go', and that there is more to be done in terms of phonic knowledge, sight words and even flash cards. But it seems unlikely that 'go' would be an unfamiliar word, given his ability to read other words in the text. Despite gathering

data from three sources, it is still unclear exactly what has prevented him from reading this small word. But what we can see in this eye tracking data is that Patrick is working hard to try to make sense of the text. He scans at length all parts of the illustration, but nothing gives him the clue to solve the word. Again, the eye movement data provides insight into Patrick's limited repertoire and flexible control of reading strategies.

So what does this tell us?

The three data collection approaches – miscue analysis, retell and eye movement – tell us much about a reader's mastery and application of reading skills and strategies. Miscue analysis affords insight into a student's text decoding skills in connection with semantic, syntactic and graphophonic information sources. The retell informs understanding about comprehension and oral language skills. And eye movement technology provides evidence into the ways these skills are applied through reading strategies. Specifically it gives evidence about where it is that a child looks, how long they look and the strategies they employ. Together, this evidence points to a range of pedagogical considerations for the ways we teach reading.

Current focus in the literature and policy on the development of phonics and phonemic awareness privileges print over the visual mode. And, of course, the development of decoding skills is an important pedagogical focus. But Patrick's reading revealed just how limiting the 'sounding out' strategy becomes as the reading challenges change. In the case of a multimodal text, such as a picturebook, the EMMA project data prompts further reflection on the ways we teach about the role of images in making meaning, raising a number of questions for consideration:

- When do we teach children to read images?
- What skills do we teach for decoding them and for understanding their role in a text?
- What do we teach our students about understanding when scanning images might be useful and when another reading strategy is preferable?
- In our commitment to developing knowledge about letters and sounds, is it possible we have overlooked an important part of the reading process?

Future directions for Patrick

Analysis of Patrick's data revealed a limited repertoire of skills and inflexible strategies for problem-solving. Specifically, Patrick predominantly relied on the initial letters in a word to predict meaning. He also looked to the images in a text as a prompt, with limited success. These low level skills are more closely aligned with early reading development and basal readers with illustrations that complement the text than with the reading required of more proficient readers. In a complex literary text such as *Looking for crabs*, with its parallel storylines carried by text and image, Peter's skills proved inadequate. It is reasonable to expect he would experience similar difficulty and frustration when reading other genres such as information texts, where the images take on a different role again.

Based on the analysis of his miscues, a teaching focus for Patrick could be about monitoring the meaning of the story as a whole text, as well as looking at all the parts of the words when reading. When we combine this with the analysis of his retell, the need for an added focus on storytelling and the development of oral language becomes clear. But when the eye movement data revealed Patrick's limited number of reading strategies and the ability to use the few strategies that he does have, the focus for teaching becomes sharper.

Developing Patrick's reading process requires a multi-pronged approach. The first is to increase the number of strategies he can apply when he comes to something he doesn't know. Note that we talk about 'something' he doesn't know rather than a 'word' that he doesn't know. For Patrick, as for many readers, the accumulation of item knowledge such as letters and words through phonic

analysis is insufficient in developing a strong reading process. This would allow him to work on developing increasingly sophisticated reading and monitoring strategies, such as reading on, rereading and checking the meaning in the text.

The second approach is to create opportunities for the oral sharing of understanding following common reading experiences; for example, discussing the novel being read or the movie being viewed during serial reading. Opportunities for talk would allow Patrick (and other students) to develop oral language skills through extended responses and engagement in conversation about the content of their reading.

And the third approach – perhaps an area of skill development required by all readers – is to spend time during reading instruction examining the role of images in a range of texts and text forms, such as paper based and digital. A particular focus for Patrick is to develop an understanding about the ways the images work in connection with the print text by examining whether they compliment, augment or contradict the content in the print; and further, to understand when it is useful to refer to the image, and when it is not.

Clearly, there is no magic bullet and students such as Patrick face considerable challenges in meeting the demands of their literacy learning. But the EMMA assessment has pointed to the need for a refocus of our reading pedagogy to encompass all sources of information on a range of texts and text forms.

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